2IB Physics HL only. Training May 2008 TM. Answers.

1. N02 H1: 12 - B

2. N02 S1: 14 - D

3. N02 H1: 18 - B

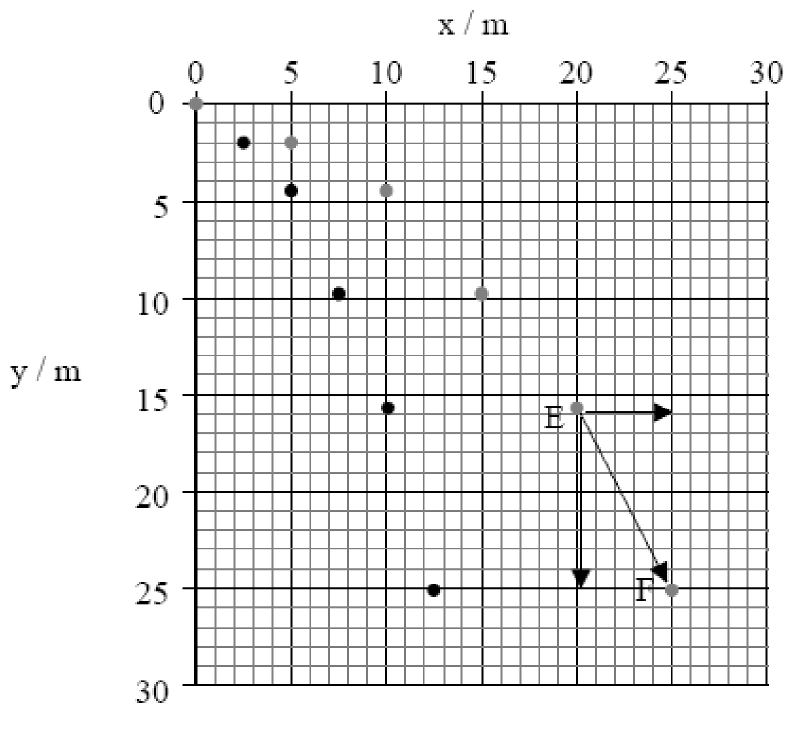
4. N02 S2: A1, H2: A1

(a) horizontal: projectile moves 5 m in 0.5 s;
so $v = \frac{5}{0.5} = 10\ \text{m s}^{-1}$;

(b) horizontal distance travelled between images is always the same;
so no significant atmosphere, since air resistance would otherwise slow the horizontal motion;

(c) different planet mass than Earth;
and different radius than Earth;

(d) displacement vector;
horizontal component vector;
vertical component vector;



(e) vertical: 9 m in 0.5 s;
$v = 18\ \text{m s}^{-1}$;

(f) half previous horizontal spacing;
same vertical positions at each time interval;

5. M02 S2: B2

(ii) $\frac{p_1}{p_2} = \frac{T_1}{T_2}$ with $T_1 = 300$ K;
to give $T_2 = 600$ K;
*Award **[1]** if K not used, 54 °C.*

recognise that change in internal energy $= ms\Delta\theta$;
$= 4.0\times10^{-3}\times3.1\times10^{3}\times300$;
$= 3.7\times10^{3}$ J;
*335 J if 27 °C used, 7.4×10^{3} J if 600 K used – award **[2]**, award **[1]** if 54 °C used – 670 J.*

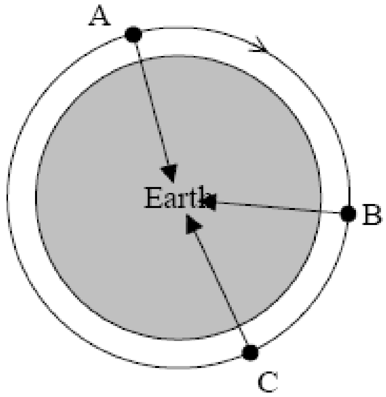
(c) (i) zero

(ii) $p_1V_1 = p_2V_2$;
with $p_1 = 2.0\times10^{5}$ Pa and $V_1 = 2V_2$;
to give $p_2 = 4.0\times10^{5}$ Pa;

(d) 3500 J

6. N02 H2: B4p1

(a)



vectors all towards the centre;
all the same length;

(b) *Look for an argument along the following lines*:
a few hundred km is small compared to radius of the Earth;
g depends on $\frac{1}{R^2}$;
so a small change in R will not produce a significant change in g;
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(c) $mg = \frac{mv^2}{R_E}$;
$v^2 = gR_E$;
$T = \frac{2\pi R_E}{v}$;
so $T = \frac{2\pi R_E}{\sqrt{gR_E}}$;
substitute $T = \frac{2 \times 3.14 \times 6.4 \times 10^6}{\sqrt{10 \times 6.4 \times 10^6}}$;
$\approx 5000\text{s} \approx 84$ min ;

(d) $\frac{mv^2}{R} = \frac{GMm}{R^2}$;

to give $v^2 = \frac{GM}{R}$;

and $T = \frac{2\pi R}{v}$;

therefore $T^2 = \frac{4\pi^2 R^2}{v^2} = \frac{4\pi^2 R^3}{GM}$;

such that $\frac{R^3}{T^2} = \frac{GM}{4\pi^2} = \text{constant}$;

(e) orbital period of geostationary satellite = $24 \times 60 = 1440$ min;

using $\frac{R^3}{T^2} =$ constant we have $\frac{{R_E}^3}{84^2} = \frac{(nR_E)^3}{1440^2}$;

to give $n \approx 7$;

or $R_{SAT} \approx 7R_E$;